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THE SCALES OF THE AFRICAN CYPRINID FISHES,
WITH A DISCUSSION OF RELATED ASIATIC
AND EUROPEAN SPECIES.

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For an opportunity to study the scales of the African Cyprinidae I am indebted to Dr. G. A. Boulenger, and the account given below is based wholly on the collections in the British Museum. In Dr. Boulenger's Catalogue of the Freshwater Fishes of Africa, Vol. I (1909), there are recognized ten genera of Cyprinidae proper, namely, *Labeo*, *Discoquathus*, *Varicorhinus*, *Barbus*, *Rasbora*, *Leuciscus*, *Leptocypris*, *Barilius*, *Neobola* and *Chelathiops*. Of these, all but *Rasbora*, *Leuciscus* and *Leptocypris* are found in the Nile basin. *Leuciscus*, or rather *Phoxinellus*, is a Palearctic type found in northern Africa; *Leptocypris* Boulenger, 1900, is a relative of *Barilius*, found in the Congo basin; *Rasbora* Bleeker is an Asiatic genus, of which one of the Asiatic species (*R. daniconius* Ham. Buch.) occurs at Zanzibar. *Chelathiops* Boulenger, 1899, is an African genus related to the Asiatic *Chela*; it occurs in the Congo basin (*C. clougatus*) and in the Nile (*C. bibie*). *Neobola* Vinciguerra, 1894, is said to be allied to the Asiatic *Bola* (which Day includes in *Barilius*); it was based on a species (*N. bottegoid*) from Somaliland, and has another (*N. argentea*) confined to Lake Victoria. It thus appears that the Ethiopian Cyprinid fauna, though numerous in species, shows very little generic differentiation, and is in all respects closely related to that of the Oriental region.

The scale-characters of the African genera, as observed in scales taken from the vicinity of the lateral line, at about the level of the beginning of the dorsal fin, are as follows:

- (1.) *Chelathiops*. *C. bibie* Joannis. River Nile. Scales broader than long, the basal and lateral circuli coarse, the apical ones much

finer, the transition abrupt; about nine delicate apical radii, and a few irregular, poorly developed basal ones. The nuclear area is a little basad of the middle, and may be broadly free from circuli, or circulate nearly to the middle. The fish is small and silvery; the scales are large in proportion, though only about $1\frac{2}{3}$ mm. across. There are no distinct laterobasal angles. Both the fish and the scales are rather suggestive of the American *Notropis*, though many differences are apparent on close comparison.

The Indian *Chela argentea* Day (Wynad, *F. Day*) has larger scales, with evident laterobasal angles. The apical radii are well defined, about 14, but several imperfect central; the basal radii are two or three, but very strong. All this shows evident resemblance to the type of radiation found in *Alestes*, and in the *pleurotania* group of *Barbus*; that is to say, with few strong radii arising from the nucleus. In *Chela argentea* this is superimposed, as it were, on a system of more ordinary apical radii, and it is only the latter that occur in *Chelathiops*.

A further study of the scales of *Chela* shows that *C. argentea* is quite exceptional, and I find one species which has scales of essentially the same type as those of *Chelathiops*, except that there are fairly well developed laterobasal angles, no basal radii, and the apical radii are greatly reduced, with not more than two or three complete. This species is *C. (Paralaubuca) typus* (type of *Paralaubuca lateralis* Sauvage) from the Mé Kong (Paris Museum). *C. anomalurus* from Sarawak has a scale of the same general character as *C. typus*, but it is excessively short and broad (long. 6, lat. 10 mm.), with no laterobasal angles, and quite numerous but very weak apical radii. On the other hand *C. clupeoides* (Murree, *F. Day*) has small scales which are much longer than broad, with six or seven apical radii and no basal. *C. bacaila* (Orissa, *F. Day*) has scales of the type of *C. clupeoides*, but with at least twice as many apical radii.

The scales of *C. macrochir* (Menam River, *Royal Siamese Museum*) are transversely oval, scarcely radiate, much like *Chelathiops* but with the coarse lateral circuli extending over into the apical region. This species has the dorsal fin very far back, and the scales were taken from the middle of the side. *Chela sardinella* (Sittang River, *E. W. Oates*) has broad weak scales with about 12 apical radii; there is a dark spot at the fork of the caudal fin.

Thus *Chela*, on the scales, seems to fall into at least three distinct groups: (1.) *C. argentea*, (2.) *C. clupeoides* and *bacaila*, (3.) *C. typus*, *macrochir* and *sardinella*, with a subgroup for *C. anomalurus*. *Chelathiops* is evidently to be compared with the third group.

The *Chelathiops* scale has quite a strong superficial resemblance to that of the Characinid *Citharinus conjicus*, although in the latter the lateral circuli are more numerous, and less abruptly differentiated from the apical.

(2.) *Neobola*. *N. argentea* Pellegrin (Bugala, Lake Victoria, Dr. E. Bayon). Small transversely elongate scales about 2 mm. broad, and not much more than 1 long; no evident angles; nuclear area a little basad of middle; apical and basal radii, but very few and feeble; lateral circuli very widely spaced, abruptly separated (about middle of side) from apical ones. A weak scale of the same type as that of *Chelathiops*. It may be even better compared with *Barilius* (*Engraulicypris*) *sardella* from Lake Nyassa; this is a slender fish with easily deciduous scales, which are transversely elongated, with the circuli as in *Neobola*, but with better defined apical radii.

(3.) *Barilius*. The following key indicates in a general way the diagnostic characters of the scales of a number of African and Asiatic species.

- Large reddish scales with many apical radii 1.
- Smaller pallid scales 2.
- 1. Scale much broader than long *B. microlepis*
(Lake Nyassa; J. E. S. Moore).
- Scale about as broad as long *B. microcephalus*
(Lake Nyassa; J. E. S. Moore).
- 2. Scales with a few very strong radiating ribs (or in reverse, grooves), and in all things resembling those of *Chela argentea* 3.
- Scales not thus marked 4.
- 3. Intervals between the few apical radii broad *B. gatensis*
(Wynad, F. Day).
- Intervals between the apical radii much narrower . *B. cauarensis*
(S. Canara, F. Day).
- 4. Scales of a rather broad type; basal radii strong; a central spot of dark pigment . . . *B. bendelisis* (Simla, F. Day) and *B. coesa* (East Indian Company's collection). These fishes are much alike.
- Scales without a dark pigment spot 5.
- 5. Thin scales of a rather or very broad type *B. sardella*
(Lake Nyassa, E. L. Rhoades), *B. ubangensis* (Kribi River at Efulen, S. Cameroon, Bates), *B. neavii* (mountain stream near Petanke, N. E. Rhodesia, S. A. Neave).
- Scales not especially broad, basal radii absent or somewhat developed 6.
- 6. African . . . *B. moorii* (Sumba, Lake Tanganyika, Cunningham: not adult), *B. loati* (Gondokoro, W. L. S. Loat), *B. kingsleyae* (S. Cameroon, G. L. Bates). *B. niloticus* also comes in this group.
- Asiatic . . . *B. tilco*, *B. andersoni*, *B. polylepis*, *B. goha*, *B. barila*, *B. guttatus*, *B. vagra*, *B. oruatus*.

In *B. tilco* there are two rows of round spots along the side. The upper row, of larger spots, alternates with the lower. *B. guttatus* has spots much as in *B. tilco*, and *B. barila* has obscure spots of the same sort. *B. ornatus* has indications of the same spots.

B. gatensis has bars in place of the spots; *B. canarensis* is obscurely barred. *B. loati* and *nearii* have vertical bars; *B. ubangensis* looks like *nearii*. *B. moorii* has rather obscure vertical bars. *B. kingsleyae* has dusky lateral spots. *B. sardella* is a slender species with easily deciduous scales. *B. niloticus* has the back dusky and the sides silvery, without bars or spots. Dr. Boulenger writes me (Dec., 1909) that he has now removed *B. sardella* from *Barilius* "and placed it, also with the *Neobola*, under the name of *Engraulicypris* Günther." As I have remarked above, the scales are very similar to those of *Neobola argentea*. The lateral circuli terminate obliquely, about the middle of the side, herein differing very conspicuously from those of *B. ubangensis* and *nearii*, which are placed in the same division in the table.

Pelotrophus Günther may be taken to include *B. microlepis* and *B. microcephalus* of Lake Nyassa, constituting a subgenus, I suppose.

Opsaridium Peters, type *B. zambesensis* Peters, I do not know.

Pachystomus Heckel includes Asiatic species with four barbels, as *B. bendelesis* and *vagra*. The name *Pachystomus* is not available, having been used more than thirty years earlier in Diptera. Day also recognizes a subgenus *Bendelisis*, for *B. barila*, a vertically barred species with two barbels, according to his description, though my notes from the fishes (Assam, *F. Day*) describe obscure spots.

According to the scale-characters, the most distinct group is that of *B. gatensis* and *canarensis*; these are placed by Day in typical *Barilius*, along with *B. tilco* and *B. guttatus*.

With the removal of *Engraulicypris*, the African *Barilius* remain a fairly compact group, with no important difference from the Asiatic forms. The large fishes called *Pelotrophus*, in Lake Nyassa, indicate a certain amount of divergence, in response to conditions not found in Asia.

- (4.) *Leptoicypris*. *L. modestus* (Banzyville, Ubanzi, Congo Free State, Capt. Royauw). Scales about $3\frac{1}{4}$ mm. long and 3 broad, with prominent laterobasal angles; nuclear area far basad; obscure rudiments of basal radii; apical radii 8 or 10, well-defined, widely spaced; lateral circuli moderately dense, in the same line with the closer apical ones. This scale is like that of *Barilius kingsleyae*, except that the apical radii are fewer.
- (5.) *Phoxinellus*. See Proc. Biol. Soc. Wash., XXII (1909), p. 216.
- (6.) *Rasbora*. I have only the Asiatic *R. argyrotaenia* (Baram, Borneo, Hose). The scale is large (about 12 mm. long and broad), with

distinct though rounded laterobasal angles; nuclear area subbasal, very broad; apical radii very numerous (45 or more), parallel; basal radii similar to apical, but finer and closer; basal circuli transverse; *apical circuli all longitudinal*, becoming irregular and more or less wavy. The character of the apical circuli is very distinctive; it is an extreme development of the condition found in *Cirrhinia jullieni*, in which the very strong apical circuli are oblique, forming with the radii angles of about 45 degrees.

(7.) *Barbus*. This immense genus will be discussed fully in a later paper; it will suffice at the present moment to call attention to some of the groupings based on the scales:

- (a.) *B. barbus* (typical) group. Scale oblong, much longer than broad; the apical circuli much coarser than the lateral; base thrown into folds, one of which projects, as in the American genus *Gila*. Also includes *B. lacertoides*. Palearctic group.
- (b.) *B. caucasicus* group. Elongate-oval scales, without the basal lobe. Numerous European species; some, as *B. bocagii*, much broader. *B. setivimensis* from the Atlas Mts. goes in this group, but the scale is broader than typical, with the lateral radii evanescent. A very distinct type is *B. grahami* from Yunnan Fu, the scales oval, extremely minute, the circuli not dense. This fish has four long barbels.
- (c.) *B. affinis* group. Scales allied to the last, but much shorter and broader, with laterobasal angles, and the lateral radii usually poorly developed. Well developed in Asia, with such species as *B. wynadensis*, *B. paradoxus*, *B. tor (mosal)*, *B. bramoides*, *B. enoplosus* (but fewer radii), *B. obtusirostris* (but peculiar), and the Persian *B. kotschyi* (but with distinct lateral radii). In the Mediterranean region it is represented by *B. callensis* (Algiers), *B. lydiacus* (type locality Smyrna), *B. ksibi* (Morocco), *B. harterti* (Morocco) and *B. sclateri* from the Guadalquivir River in Spain. African species are *B. bynni* (R. Nile), *B. affinis*, *B. surkis*, *B. oreas* (few apical radii).
- (d.) *B. macmillani* group. Much like the last; no lateral radii; basal radii few. Also includes the African *B. tropidolepis* and the Asiatic *B. armatus*. A doubtfully valid group.
- (e.) *B. kolus* group, also including *B. waldoi* from Morocco. Scales longer and narrower than in the last group, the laterobasal angles more rounded. The base of the scale is truncate, not rounded as in the *caucasicus* group.
- (f.) *B. gonionotus* group, including also *B. javanicus* and *B. altus*, all Asiatic. Base of scale wavy; lateral radii oblique. May be regarded as a long form of the next group.

(g.) *B. chilotes* group. Broad scales, about as broad as long, the laterobasal angles fairly strong, the lateral radii usually bent inwards centrad, or the outer ones failing. A very common type of scale, including the African *B. chilotes*, *platystomus*, *gorguari*, *erlangeri*, *plagiostomus*, *duchesnii*, *oreas* (between this and the *affinis* group), *batesii*, *rueppelli*, *lobogenys*, *altianalis*, *nedgia*, *ruspolii*, and *radeliffii*.

Asiatic species are *B. lithopidos* (but lateral radii not curved basally), *hexastichus*, *douronensis*, *thomassi*, *carnaticus* (lateral radii very many), *malabaricus* and *jerdoni*.

(h.) *B. micropogon* group. Much like the last, but very broad scales, broader than long. Includes the Asiatic *B. micropogon*, *jarsinus* (hardly so broad), *oatesii* and *sharpeyi* (Persia). Also the African *B. leptosoma* (not nearly so broad), *rothschildi* (Morocco), and *progenys*.

(i.) *B. longiceps*, from the Lake of Galilee, has a peculiar quadrate scale with rounded corners, and very many radii, apical and basal.

(j.) *B. bowkeri* group. Shape nearly as in *affinis* group, laterobasal angles evident; middle of base emarginate; radii well developed all round. Here go the Asiatic *B. chilinooides* (*himalayensis*) and *macronema* (large scale, rather peculiar), and the African *B. bowkeri* (*mariquensis*), *gregorii* (but basal radii fewer, and weak; lateral radii weak), *intermedius* (but basal radii longer, nuclear area normal), *inermis* (much like *intermedius*), *gudariensis* (large scale), *margarita*, *hursensis*, *bottegoi* and *fritschii*, the last from Morocco. The nuclear area is usually broadly granular.

(k.) *B. apogon* group. Much like the last in form, but no lateral radii, and basal radii nearly obsolete, or with a single one going to the notch. Includes the S. African *B. holubi*, and the Asiatic *B. schlegelii* (Formosa and Japan), *labeo*, *collingwoodii*, *maculatus*, *repasson*, *esocinus* (Persian Gulf), *yunnanensis*, *apogon*, *chagunio* and *compressus* (but apical radii fewer, and two or three weak basal radii).

(l.) *B. brevibarbus* group (African). Much like the last, but scale obtusely triangular; a slight tendency to polygonal areas in nuclear region, affording some transition to the following groups.

The four following groups are closely related, and very distinct from all the previous ones, having a few very strong radii (apical and basal) coming from the nuclear area, in the manner of the Characiniid genus *Alestes*. This may be called alestiform sculpture. In many cases the nuclear area is broken up into polygonal spaces; this may occur or be absent in scales from the same fish.

(m.) *B. pinnauratus* group. Scale subquadrate, at least as long as broad, with rather numerous strong radii. Includes the Asiatic

B. pinnauratus, *sarana* (large scale, with basal region larger), *sebanicus*, *dorsalis*, *chola*, *pleurotania*, and the African *B. perince* (R. Nile) and *camptacanthus*.

(n.) *B. goniosoma* group. Like the last, but the polygonal nuclear pattern excessively developed. Includes the Asiatic *goniosoma*, *maculatus* (fish very like *goniosoma*) and *burmanicus*. The African *B. gurneyi* (*natalensis*) may go here, but is peculiar.

(o.) *B. burchelli* group. Like *pinnauratus* group, but scales broader. Lateral circuli coarse in *burchelli*, fine in others, as *mahecola*. Includes the African *B. burchelli*, *taniurus*, *capensis*, *aspilus*, (some polygonal areas), *guirali*, *nummifer*, *rhoadesi* (but radii weak) and *trispilus* (*walkeri*). Asiatic species are *B. lateristriga* (scale not so broad), *palawanensis*, *hampal* (immense scale, not so broad) and *mahecola*.

(p.) *B. chrysopoma* (Asiatic). Scale of the *pinnauratus* type, but long, with the nuclear area far apical.

It is not suggested that all these groups are natural, but to some extent at least they must be significant. Later studies will no doubt suggest modifications, especially when the characters of the fishes are correlated. Some generic and subgeneric names are applicable as follows:

Cheilobarbus A. Smith. Type, *capensis* (gr. o.)

Pseudobarbus A. Smith. Type *burchelli* (gr. o.)

Anemateichthys Bleeker. Type *apogon* (gr. k.)

Hemibarbus Bleeker. Type *barbus* Schlegel (*schlegelii*) (gr. k.)

Labeobarbus Rüpp. Type *nedgia* (gr. g.)

Numerous other names have been proposed for subdivisions of *Barbus*, which is here interpreted in the broadest sense, following Boulenger. No doubt some of these represent valid genera, and it is probable that *Barbus* should be restricted to the Palearctic groups, but I am not in a position to propose a new classification. According to any reasonable scheme, it appears that enough generic names already exist to supply all requirements, unless perhaps a name should be proposed (at least in a subgeneric sense) for *B. grahami* of Regan.

Day, in his work on the species of British India, recognized three subgenera:

Barbodes, with four barbels.

Capoëta, with two barbels.

Puntius, without barbels.

I have examined the scales of 17 of his *Barbodes*, five of his *Capoëta*, and two (*apogon* and *filamentosus*) of his *Puntius*. On the scale characters, the groups do not hang well together, and for this and other reasons I believe they are to a considerable extent artificial. Day calls attention to the great resemblance between *B. mahecola*, which has four barbels, and *B. filamentosus*, which

has none, and even raises the question whether they are distinct species.

(8.) *Varicorhinus*. An Asiatic and African genus related to *Labco* and *Barbus*. I have examined three species:

V. beso. Hawash River (*Zaphiro*). Scale about $11\frac{1}{2}$ mm. long and 14 broad; laterobasal angles much greater; basal and lateral circuli very fine, apical (on exposed part of scale) abruptly differentiated, very coarse, broken up into tubercles between the radii; nuclear area nearly central; apical radii numerous, about 40, parallel, not very conspicuous; basal radii three or four, feeble and broken. This rather recalls some of the *Labco* scales, but is much broader, and without or with only faint traces of the curved lateral radii. This is the type of the genus.

V. tanganicæ. Lake Tanganyika (*Cunnington*). Small delicate scales about 4 mm. long, about as broad as long, varying to broader than long, obtusely subtriangular, with a broad basal median lobe. Nuclear area broadly roughened; lateral and basal circuli widely spaced, or the basal fairly dense; apical circuli evanescent; apical radii about 18, delicate, wavy; basal radii as in *V. beso*. Very distinct from *V. beso*.

V. maroccanus. Oum Erbiah, Morocco (*Riggenbach*). Not adult. Scales subquadrate, about 6 mm. long and $6\frac{1}{2}$ broad; structure essentially as in *V. beso*, with the same sort of tuberculate apical circuli. Apical radii about 16; nuclear area circulate to middle or very broadly rugose; feeble and broken basal radii rather numerous. Belongs to the subgenus *Pterocapoïta* Günther.

In Boulenger's key, *V. beso* goes in the first division, with three other species, while *V. maroccanus* and *tanganicæ* form the second. It seems evident, however, that the two latter are not closely allied. *V. maroccanus*, in spite of several peculiarities, must be grouped with *V. beso*, while *V. tanganicæ* Boulenger forms a group apart. The *tanganicæ* group is distinguished not only by the small size (64-70 in lateral line) and sculpture of the scales, but by the dorsal originating above the ventrals, the last simple ray very strong and ossified, the large eye, the reduction of the barbels to a single rudimentary pair, and the falcate apex of the dorsal and of the caudal lobes.

Dr. Boulenger (1901) originally described *V. tanganicæ* as a member of the Asiatic genus *Capoïta*, writing as follows:

"The discovery of a species of this genus in Lake Tanganyika is particularly interesting from the fact that only one was known from Africa, viz. the Abyssinian *C. dillonii* C. and V.; this is distinguished by the absence of barbels and the greater size of the scales (30 to 32 in the lateral line). In the presence of a pair of barbels and the small size of the scales, *C. tanganicæ* belongs to

the typical section of the genus, inhabiting southwestern Asia; but it has the enlarged dorsal ray neither feeble as in *C. fundulus* Pall. and allied species, nor serrated as in *C. trutta* Heck."

C. dillonii is now placed by Dr. Boulenger in the synonymy of *V. beso*. Upon comparing the scales of *V. tanganicæ* with those of Asiatic *Capoëta*, I find a very marked resemblance. *Capoëta fundulus* (Kurá River, St. Petersburg Museum) has scales closely like those of *V. tanganicæ* in size, sculpture and consistency, but broader, with the apical radii strong and not wavy. *C. steindachneri*, Kessl, is rather more modified, the scales being longer than broad, with strong laterobasal angles, and the subapical circuli forming strong oblique ridges. The scales of *C. (Gnathopogon) gracilis* are close to those of *V. tanganicæ*, but the apical radii are stronger, and the tubercles formed by the circuli between them are large.

All things considered, *V. tanganicæ* does seem to stand apart from true *Varicorhinus*, and shows some affinity with *Capoëta*. It may therefore be taken as the type of a new subgenus АСАРОËТА.

- (9.) *Discognathus*. A genus of southern Asia and northeast Africa, especially found in torrents and mountain rivers, having a more or less developed snectorial disc on the chin. The skin is usually thick, and is always beset with numerous minute pigment dots; in *D. johnstonii* these are rather larger and very dense, producing a sort of fine marbling. According to Day, typical *Discognathus* of Heckel, which I have not seen, has only one pair of barbels. The Indian and African species have two pairs, and go in the subgenus *Garra* Ham. Buch. The only Asiatic species I have examined is *D. lamta* from Harnai, Afghanistan (*F. Day*). This has subquadrate scales, broader than long (about 6 mm. long and $6\frac{1}{2}$ broad), the apical half covered by the yellow skin. Laterobasal angles evident but obtuse; basal and lateral circuli very fine; apical radii excessively fine and numerous, only about 70 to 90 μ apart, giving the idea that they may be merely coarse longitudinal circuli, but the remains of the true apical circuli (following the line of evolution initiated by *Varicorhinus*) are visible as rounded tubercles between the radii; basal radii irregular and poorly developed, as in allied forms. This scale can easily be recognized as an extreme modification of the *Varicorhinus* type. The apical tubercles (remains of circuli) are suggestive of those found in *Capoëta gracilis* though of course they are much smaller.

The four African species of *Discognathus* seen by me have smaller and broader scales (4 mm. broad and 3 long in *D. johnstonii*, the others a little smaller).

D. blanfordii. Jerrer River, near Harrar (*E. Degen*). Formerly confused with *D. lamta*, with which the scale agrees in all important features. The basal radii are fairly numerous, but very irregular.

D. johnstoni. Victoria Nyanza (Sir II. Johnston). Appearance of scale much as in *D. blanfordii*, but the laterobasal angles have wholly disappeared, and the broad nuclear area is broken up by a number of short irregular lines. The apical radii extend to the side of the scale, where they are obliquely crossed by the circuli. The lateral circuli are not so regular as in *D. lamta*.

D. quadrimaculatus. Lake Zwai (Zaphiro). Scale much as in *D. blanfordii*. Laterobasal angles rudimentary; nuclear area very far basad; apical radii extremely fine, the middle ones about 50μ apart; lateral radii irregular and widely spaced, obliquely crossed by circuli; apical circuli represented by scattered round tubercles.

D. dembeensis. Matti R. (Blue Nile) (*P. C. Zaphiro*). Thin scales embedded in thick skin. Scales essentially as in *quadrimaculatus*, the nuclear area far basad. The short basal radii are well developed, and extend laterally in an irregular manner, so that the scale is radiate all round.

Thus, so far as the scales go, the genus *Discognathus* hangs well together, and is separable from *Varicorhinus* by the extreme closeness of the radii.

(10.) *Labco*. The scales of this large genus may be divided into a number of groups, as in *Barbus*.

(a.) *L. fimbriatus* group. Scales very long, parallel-sided, rounded apically, truncate basally; those of *fimbriatus* are about 15 mm. long and 9 broad. A very distinctive group, approached, but not nearly equalled, in *Barbus* by the group of *B. gonionotus*. The species are Asiatic, including *L. cursa*, *microphthalmus*, *karrus*, *gonius*, *fimbriatus*, *bata*, *koutius*, *leschenaultii*; and as a subgroup with shorter scales *L. dussumieri*, *pangusia*, *chalybeatus* and *nigripinnis*. The apical circuli are broken up into tubercles; the apical radii differ, being much more numerous in *L. bata* than in *L. fimbriatus*. One African species, *L. barbatus* Boulenger (Boma, Lower Congo) might be classed with the shorter-scaled division of this group, but it is really a rather narrow-scaled member of the *macrostoma* group.

(b.) *L. macrostoma* group. Scales of the subquadrate type, but not much elongated; basal margin obtusely lobed in middle. I have placed here the Asiatic *L. calbasu* and *falcatus* (*dyochilus*), but the latter is broader. The African species are numerous, including *L. macrostoma*, *niloticus* (few basal radii), *annectens* (but broader), *cylindricus*, *mesops*, *relifer* (large reddish scale), *forskali*, *greenii* and *victorianus*. The large scales of *L. victorianus* are badly infested by some parasite.

(c.) *L. sladoni* group. Like the last, but no basal radii, and the basal margin straight, or not obviously lobed. This group consists

of two lots of species, one Asiatic, the other from the Transvaal. The Asiatic members are *L. sladoni* (Mandalay, *F. Day*), *L. ricnorhynchus* (Jamu, Himalayas, *Schlagintweit*), *L. bicolor* (Calcutta, *F. Day*), *L. sindensis* and *L. diplostomus*. The Transvaal ones are *L. rosea*, *ruddi* and *capensis*. This group probably has no proper standing, but consists rather of slightly divergent members of the last.

(d.) *L. altivelis* group. The often large scales sculptured about as in the *macrostoma* group, but subcircular, without laterobasal angles. All African, including *L. altivelis*, *senegalensis*, *lineatus*, *coubie* (many basal radii), *darlingi* and *umbratus*. The last is the type of *Abrostomus* A. Smith. *L. horie* forms a subgroup with reduced sculpture.

(e.) *L. walkeri* (*brachypoma*) group. Type of *macrostoma*, but the scales becoming obtusely subtriangular. This may be compared with the *breccibarbis* group of *Barbus*.

(f.) *L. chrysophekadion* group. This species, from the Menam River, Siam, is very distinct by the character of the apical circuli, which instead of being broken up into tubercles, are continuous, and meet at a sharp angle in the middle line, as in *Cirrhinia jullieni*. They are however denser than in the *Cirrhinia*. *L. rohita* from Calcutta (*Thos. Moore*) has essentially the same structure, but the circuli are more or less broken up into tubercles. The shape of the scale is essentially as in the *macrostoma* group.

It will be seen that the grouping of *Labeo* here given does not accord well with that based (e. g. by Boulenger) on the fishes. There is however a tendency for the groups to agree with geographical areas, and it is probable that they have some real significance. No doubt some of the groups are artificial, including similar looking scales which actually have different origins.

Regarded as a whole, the African Cyprinid fauna presents some curious historical problems. Africa is the home of a varied fauna of Characinids, which belong to endemic genera. As America was probably the home of this family, and in view of the distinctness of the African Characinid fauna from that found in the Neotropical Region, it must be supposed that the arrival of the Characinids in Africa took place very long ago, perhaps in the Mesozoic. On the other hand, the Ethiopian Cyprinid fauna is obviously Asiatic, and the amount of endemism (aside from species) is so slight that we must postulate a more recent period of arrival, certainly Tertiary, perhaps not earlier than Miocene. It is curious that with the country so well stocked in advance with Characinids, it was possible for the Cyprinids to spread even to the extreme south, and produce such a large number of specific forms. This may be due in part to a greater adaptability (already well developed in Asia)

to upland streams, as may be suggested by the great number and variety of species in Abyssinia.

Another interesting feature is the palearctic fauna, poor in species, in north Africa. This fauna does not have things all its own way. It seems natural enough that Ethiopian types should come down the Nile into Lower Egypt, but it is curious that the surprisingly rich (as to species) fauna in the Atlas Mountains should be mixed, Palearctic and Ethiopian. This seems to point to former (Miocene) conditions in the Sahara region, very different from those observed to-day.